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Traumatic Dental Injuries of Permanent Anterior Teeth in Children referred to Dental School of Tehran University of Medical Sciences: A Retrospective Study

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Objectives Children frequently encounter dental problems related to traumatic dental injuries (TDIs). This study aimed to investigate TDIs among children aged 7-13 years, who were admitted to the Tehran School of Dentistry in Tehran, Iran.
Methods This retrospective study was performed on 70 patients with 129 TDIs. Information, such as age at the time of the accident, gender, cause and type of TDI, the interval between the accident and the emergency care, and treatment, was gathered from the patients' records. During the follow-up session, the pulp sensibility, probing, and percussion tests were conducted. The collected data was statistically analyzed using Fisher's exact test and Chi-square test. The significance level was set at $P<0.05$.
Results A total of 129 TDIs were reported during 2018-2021. Maxillary central incisors (80.62%) were the most commonly involved teeth, followed by maxillary lateral incisors (17.82%) and mandibular lateral incisors (1.55%). Falls were the main contributor to TDIs (31.78%). The most frequent TDIs involved enamel-dentin fractures without pulp involvement (37.20%) and subluxation (19.37%), followed by enamel-dentin fractures exposing the pulp (10.85%), avulsion (10.85%), infraction (4.65%), lateral luxation (3.87%), intrusion (3.87%), and extrusion (3.10%). Splinting (26.61%) and restoration (23.74%) were the most frequent treatments. The average follow-up period was 2-3 years, with a survival rate of 67%.
Conclusion It appears that a significant number of parents are unaware of the necessity of immediate treatment and regular follow-up after TDIs, which can result in a high rate of treatment failure.
Keywords Tooth avulsion; Tooth fracture; Tooth injuries; Tooth luxation; Trauma

Introduction

Traumatic dental injuries (TDIs) represent a significant dental emergency in children and adolescents. These injuries can have severe medical, aesthetic, and psychological implications. [1, 2] The incidence of TDIs fluctuates based on age and gender. They are notably prevalent in children and adolescents, with an incidence rate of approximately 20%. [3] Nearly 80% of tooth injuries occur before the age of 20 years, making children and adolescents particularly vulnerable to dental traumas (DTs). [4]

Based on the global male-to-female ratio of 1.43, men are more likely to experience TDIs than women. [5] Depending on the severity, type, and delay in the treatment of DTs, different complications, including tooth discoloration, pulp necrosis, external and/or internal root resorption, and injuries to the gingiva and oral mucosa may occur. [6-8] These injuries can also have an impact on the craniofacial growth. [9] Therefore, devising an effective treatment plan for such patients necessitates the collaboration of specialists from various dental disciplines. [10]

Emergency care following TDI is typically required to enhance dental prognosis and avoid complications. Dental avulsion is a type of dental emergency where immediate intervention is necessary to preserve the tooth. [11] The success rate for replanting avulsed teeth may not always reach 100%, even in cases of immediate replantation. Therefore, emergency aid should be administered at the scene. While this is ideally done by healthcare professionals, it can be also provided by parents, teachers, or other informed individuals who are present at the scene. [11] However, research indicates that parents and teachers often do not possess adequate knowledge to respond effectively to DT emergencies. [12-14]

Children who have experienced trauma to their anterior teeth often exhibit a greater reluctance to smile and express more concern about their appearance compared to children who have not experienced tooth injuries. [15] Similarly, children with untreated DTs often experience feelings of shame and social isolation and may suffer from a diminished quality of life related to oral health. [16] Beyond the functional, physical, and psychological impacts of TDIs, the cost of treatment can be substantial. [17] Several factors, including age, socioeconomic status, and environmental influences, play a crucial role in the etiology of DTs. Adolescents who are in lower socioeconomic positions and face adverse environmental conditions are more likely to experience TDIs compared to those who have positive life experiences and financial support. [18]

The treatment of traumatized teeth in children can be unpredictable, complex, and costly. This process can extend throughout a person's lifetime and significantly impact their quality of life. [19] The outcome of treatment is largely dependent on the dentist's expertise and the immediate first aid provided at the accident scene. Therefore, not only dentists need to be well-informed in this area, but also parents and teachers should possess sufficient knowledge. [20, 21]

The Faculty of Dentistry at Tehran University of Medical Sciences (TUMS) is often a primary choice for patients with TDIs in Tehran, Iran. Many general dentists may lack the necessary skill and experience in management of these cases, leading to their referral. [14, 15] The present study aimed to characterize the nature of dental injuries in patients aged 7-13 years, who were treated at the Dental School of TUMS, by evaluating factors such as gender, age, cause of injury, type of injury, the teeth affected, and the time elapsed until the first emergency care.

Methods and Materials

This retrospective study utilized clinical and radiographic data from patients aged 7-13 years, who were referred to the pediatric department of TUMS due to trauma to their anterior permanent teeth. The study covered a 41-month period from February 2018 to June 2021, and all included patients had completely received at least one year of treatment. Sampling was conducted using a census method. The study protocol was approved by the Ethics Committee of TUMS. Parents were informed about the study and how their child's dental records would be used anonymously. Informed consent was obtained from each patient or their guardians prior to their inclusion in the study.

The criteria for eligibility in this study were children who had experienced TDIs to their permanent teeth and received treatment at the Dental School of TUMS, with at least one year passed since the trauma. Cases involving jaw fractures were not included in this study.

Data collection

The data for this study was gathered from the original paper records of 70 children, as well as the results of clinical examinations conducted during a follow-up session. Data including the baseline information about the patient, the cause and type of TDI according to the criteria proposed by Andreasen et al., [22] injured tooth, and the interval between the injury and the first visit to the dentist, was collected (Table 1). The information from the patient examination records is presented in tables as frequencies and percentages.

Table 1- The categorized information of TDIs among the patients

Category	Characteristic
Background information	Age (7-9, 10-13 years); gender (boy, girl)
Cause of TDI	Fall, fight, bicycle, playing
Type of trauma according to Andreasen et al	Fractures: uncomplicated crown-root fracture (without pulp involvement), complicated crown-root fracture (with pulp involvement), root fracture. luxations: concussion, subluxation, extrusion, lateral luxation, intrusion, and avulsion
Time from injury to first visit to the dentist	First hour, 1-12 hours
Treatment	Restoration (GIC, composite, bonding the fractured piece), pulp capping (Ca(OH) ; MTA); pulpotomy; root canal treatment; repositioning, tooth splinting; tooth extraction;

Statistical analysis

The collected data was systematically analyzed using SPSS Version 22 (SPSS Inc., Chicago, USA). The data was subjected to statistical analysis using the Chi-square test to determine the relationship between categorical variables, and the Fisher's exact test was used where necessary. The significance level was set at $P<0.05$.

Results

In this study, 70 patients with TDIs (70% male and 30% female), aged 7-13 years, were examined. The highest number of TDIs occurred among children aged 7-9 years (n=88, 68.22%), although this number decreased with age (n=41, 31.78%) (Table 2). A total of 129 permanent teeth were examined, including 104 (80.62%) maxillary central incisors, 23 (17.82%) maxillary lateral incisors, and 2 (1.55%) mandibular lateral incisors.

Table 2 presents the distribution and frequency of various types of TDIs in permanent dentition. Subluxation (19.37%) and simple crown fractures (37.20%) were significantly more prevalent than other types of injuries ($P<0.05$). Avulsion occurred in 14 (10.85%) teeth. Maxillary central incisors were the most affected teeth in both age groups. The type of TDI was not significantly different between males and females.

The occurrence of TDIs varied across the two age groups: children aged 7-9 years (n=88, 68.21%) and children aged 10-12 years (n=41, 31.78%). Girls were found to be more prone to TDIs when they were younger (n=13, 61.90%) compared to when they were older (n=8, 38.09%). In contrast, the incidence of TDIs in boys showed no variation with age.

Figure 1 demonstrates the causes of TDIs. Falling was the main contributor to TDI (31.78%), followed by fighting (33.35%), riding a bike (13.95%), and playing games (13.95%). The cause of TDIs did not differ significantly between the age groups ($P=0.546$). Home (23%), school

(15%), and playground (8%) were the most common places of TDIs.

Table 2- Distribution of dental trauma based on age

Dental trauma		7-9		10-12 and 13		total	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Distribution of injuries leading to luxation by age	Concussion	3	75	1	25	4	3.10
	Subluxation	21	84	4	16	25	19.37
	Lateral luxation	4	80	1	20	5	3.87
	Extrusion	8	100	0	0	4	3.10
	Intrusion	3	60	2	40	5	3.87
Distribution of dental hard tissue injuries by age	Avulsion	13	93	1	7	14	10.85
	enamel splicing	2	33	4	67	6	4.65
	Simple crown fracture	15	45.5	18	54.5	33	25.58
	Complex crown fracture	18	62	11	38	29	22.48
	Root fracture	4	100	0	0	4	3.10
Total		88		41		129	100

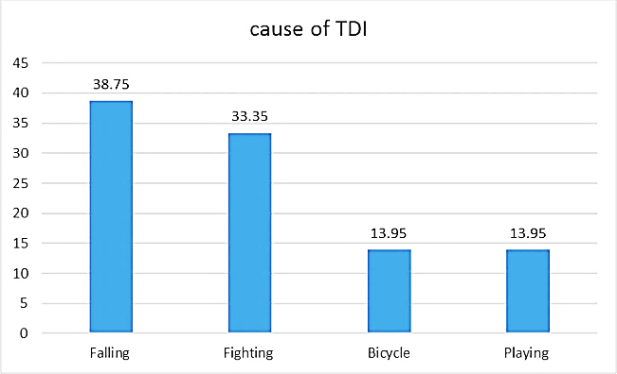

Figure 1: The cause of TDI

A noticeable delay was observed in seeking dental care following a TDI. Specifically, less than 1% of children were brought to the clinic within the first hour post-TDI. Furthermore, approximately 34% of patients arrived at the clinic within a time frame of 1-12 hours post-TDI. No cases of avulsion received urgent dental care within the first hour of injury. Also, the time elapsed from the occurrence of a TDI to the point of receiving dental care did not show a significant difference (P= 0.093) between boys and girls or between the two age groups.

Table 3 shows the treatments for patients with TDIs. The most common treatments for TDIs included the splinting of the injured tooth (26.61%), restoration procedures (involving the use of composite or glass-ionomer materials or reattaching the fractured piece of a tooth) (23.74%), and patient follow-up without any immediate intervention (20.14%). Overall, 15 (54%) patients showed signs of posttraumatic complications that necessitated further treatment. The most frequent complication was the formation of pulp necrosis and periapical lesions (61%), followed by calcification (18%), ankylosis (14%), and other complications. Generally, the choice of storage medium for an avulsed tooth plays a crucial role in the success of the treatment. Of the 14 avulsed teeth, half (50%) were stored in water, while 28.57% were kept in milk, and 21.43% were stored in dry media.

Table 3- The frequency of treatments for TDIs patients

Treatment	Frequency (%)
Only Follow up	28 (20.14)
Restoration	33 (23.74)
Splint	37 (26.61)
Replanting	14 (10.07)
Pulpotomy	16 (11.51)
Apexification Apexogenesis	11 (7.91)

Discussion

This retrospective study analyzed the dental records of patients aged 7-13 years, who were referred to the university clinic due to TDIs during 2018-2021. In line with numerous studies, TDIs were found to be more prevalent among boys. [23-25] Also, based on the results, patient referral to emergency dental care was reported to be significantly delayed.

Children around the world, regardless of their age, frequently experience TDIs. The global frequency of TDIs in permanent dentition has been estimated to be 15.2%. [5] It is known that the distribution of TDI varies by country and culture. For example, TDI has been reported in 11.4% of Nigerians, [26] 13% to 10.9% of Indians, [7, 27] 21% of Brazilians, [28] 36% of Iranians, [29] and 18.5% of Canadians. [5] Several potential factors could account for the varying prevalence of TDIs among children in different regions of the world. These might include the differences in study design, sample size, sampling techniques, inclusion and

exclusion criteria, and measurement methods. Also, different behavioral, cultural, and environmental factors in different geographical areas may be influential. [30, 31]

In this study, a total of 70 children with 129 trauma-affected teeth were examined. The majority of TDIs were observed in school children aged 7-9 years, accounting for 69% of the cases. These findings were consistent with the results of similar studies. [32-34] In the present study, consistent with other previous research, [5, 24, 28, 31] TDIs were found to be more prevalent in boys (70%), compared to girls (30%). This trend is thought to be linked to gender-specific emotional and behavioral factors. [35] For instance, boys demonstrated a higher inclination towards engaging in contact sports and exhibited more aggressive behaviors. Additionally, they were often less mature compared to their female counterparts. [36]

In the current study, the most common cause of TDI was falling (38.75%), which is in line with other research findings. [25, 32, 37] This study identified activities, such as playing, bicycling, and fighting, as major contributors to TDIs. These findings are consistent with those reported in other studies. [23, 38] Also, the maxillary central incisors were the most frequently injured teeth in this study (84%), which is in line with the findings of previous research. [39, 40]

Additionally, based on the current results, less than 1% of patients sought emergency care within the first hour of the injury, and 34% received care within 1-12 hours of the injury. Generally, timely urgent care is crucial for successful treatment, and any delay between the injury and obtaining urgent care can negatively impact both the prognosis of tooth survival and the overall outcome of the treatment, [41] especially in avulsion cases. [39, 42] One possible reason for this delay in accessing emergency care could be the unavailability of immediate emergency services when a trauma occurs. Research has shown that the knowledge of parents and teachers regarding the need for immediate dental referral following a TDI is often insufficient. [43] Another contributing factor could be that patients often delay seeking treatment until they experience symptoms, such as pain, difficulties with chewing, or aesthetic concerns. A systematic review and meta-analysis by Tewari et al. revealed that teachers in schools often have low confidence and low levels of knowledge about TDIs. [44]

In the present study, the criteria proposed by Andreasen et al. was used to classify TDIs. [22] In line with other studies, [45, 46] the most common type of dental damage observed was a fracture involving both the enamel and dentin without any pulp involvement (37.20%), followed by subluxation (19.37%). There was no significant difference regarding the type of injuries between the two age groups.

Dental avulsion occurred in 10.85% of all TDIs, which is higher than the rates reported in other studies. [23, 33, 38] This discrepancy could be potentially attributed to the fact that dentists in private practice may only refer the most severe TDI cases to the dental department of the university. Research among general dentists in Isfahan, Iran, revealed that they lacked adequate knowledge of TDIs. [47] Similar findings have been reported by researchers across various countries, as highlighted in the Global Survey of Dental Professionals' Knowledge conducted by Tewari et al. [44]

In the present study, the most common side effects of TDIs were pulp necrosis with or without periapical disease (61%) and canal obliteration of permanent teeth (18%). One potential reason for treatment failure could be the delay in accessing emergency care. By the age of 7-9 years, the root development of permanent incisors is not yet complete. A delay in obtaining urgent care can increase the risk of complications, thereby reducing the viability of vital teeth and potentially diminishing the prognosis of treatment. [23]

According to the present results, the most frequent treatment was the restoration of fractured teeth (23.74%), followed by splinting (20.14%). This observation contradicts the study conducted by Atabek et al., where root canal therapy was identified as the most common treatment. [24] Some studies have shown that follow-up is the most frequent procedure after TDIs. In the study by Atabek et al., [24] the most affected teeth were maxillary anterior teeth. In the present study, it was found that 84% of injuries were associated with the maxillary central incisors. This could be attributed to their most anterior position in the jaw compared to other teeth, making them more susceptible to damage and impact.

Generally, population-based epidemiological research on the frequency and severity of TDI is insufficient. [31] The current study, which was conducted at the Pediatric Department of the Tehran Faculty of Dentistry from 2018 to 2021, focused on a sample of patients with TDIs. However, it included a relatively small number of cases. Therefore, the findings may not be representative of the broader population, and future studies on the prevalence, etiology, and severity of TDIs are essential.

Conclusion

In this study, falling and fighting were identified as the two most common causes of TDIs, respectively. The most frequently observed TDIs involved fractures of the enamel and dentin without pulp involvement, as well as subluxation. Pulp necrosis and the formation of periapical lesions were identified as the most common complications following TDIs. A significant delay was observed in patients seeking emergency dental care, suggesting a lack of awareness among parents and teachers about the importance of immediate care following a TDI. Therefore, the implementation of more educational programs focused on TDIs is recommended for students, teachers, and parents.

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Conflict of Interest

No Conflict of Interest Declared ■

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